SEQUENCE LISTING

<110>   ASAKURA, YOKO
        NAKAMURA, JUN
        KANNO, SOHEI
        SUGA, MIKIKO
        KIMURA, EIICHIRO
        ITO, HISAO
        MATSUI, KAZUHIKO
        OHSUMI, TSUYOSHI
        NAKAMATSU, TSUYOSHI
        KURAHASHI, OSAMU

<120>   METHOD OF CONSTRUCTING AMINO ACID PRODUCING BACTERIAL STRAINS, AND
METHOD OF PREPARING AMINO ACIDS BY FERMENTATION WITH THE CONSTRUCTED AMINO ACID
PRODUCING BACTERIAL STRAINS

<130>   0010-1108-0 CONT

<140>   09/577,005
<141>   2000-05-25

<150>   PCT/JP99/05175
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<150>   JP 271786/1998
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Phe Ala Met Ile Arg Asp Gly Val Ala Ser Tyr Leu Asn Asp Ser Asp     96
            20                  25                  30

ccg gag gag acc aac gag tgg atg gat tca ctc gac gga tta ctc cag
Pro Glu Glu Thr Asn Glu Trp Met Asp Ser Leu Asp Gly Leu Leu Gln     144
        35                  40                  45

gag tct tct cca gaa cgt gct cgt tac ctc atg ctt cgt ttg ctt gag
Glu Ser Ser Pro Glu Arg Ala Arg Tyr Leu Met Leu Arg Leu Leu Glu     192
    50                  55                  60

cgt gca tct gca aag cgc gta tct ctt ccc cca atg acg tca acc gac
Arg Ala Ser Ala Lys Arg Val Ser Leu Pro Pro Met Thr Ser Thr Asp     240
65                  70                  75                  80

tac gtc aac acc att cca acc tct atg gaa cct gaa ttc cca ggc gat
Tyr Val Asn Thr Ile Pro Thr Ser Met Glu Pro Glu Phe Pro Gly Asp     288
                85                  90                  95

gag gaa atg gag aag cgt tac cgt cgt tgg att cgc tgg aac gca gcc
Glu Glu Met Glu Lys Arg Tyr Arg Arg Trp Ile Arg Trp Asn Ala Ala     336
            100                 105                 110

atc atg gtt cac cgc gct cag cga cca ggc atc ggc gtc ggc gga cac
Ile Met Val His Arg Ala Gln Arg Pro Gly Ile Gly Val Gly Gly His     384
            115                 120                 125

att tcc act tac gca ggc gca gcc cct ctg tac gaa gtt ggc ttc aac
Ile Ser Thr Tyr Ala Gly Ala Ala Pro Leu Tyr Glu Val Gly Phe Asn     432
    130                 135                 140

cac ttc ttc cgc ggc aag gat cac cca ggc ggc ggc gac cag atc ttc
His Phe Phe Arg Gly Lys Asp His Pro Gly Gly Gly Asp Gln Ile Phe     480
145                 150                 155                 160

ttc cag ggc cac gca tca cca ggt atg tac gca cgt gca ttc atg gag
Phe Gln Gly His Ala Ser Pro Gly Met Tyr Ala Arg Ala Phe Met Glu     528
                165                 170                 175

ggt cgc ctt tct gaa gac gat ctc gat ggc ttc cgt cag gaa gtt tcc
Gly Arg Leu Ser Glu Asp Asp Leu Asp Gly Phe Arg Gln Glu Val Ser     576
            180                 185                 190

cgt gag cag ggt ggc att ccg tcc tac cct cac cca cac ggt atg aag
Arg Glu Gln Gly Gly Ile Pro Ser Tyr Pro His Pro His Gly Met Lys     624
    195                 200                 205

gac ttc tgg gag ttc cca act gtg tcc atg ggt ctt ggc cca atg gat
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210             215             220

gcc att tac cag gca cgt ttc aac cgc tac ctc gaa aac cgt ggc atc     720
Ala Ile Tyr Gln Ala Arg Phe Asn Arg Tyr Leu Glu Asn Arg Gly Ile
225             230             235             240

aag gac acc tct gac cag cac gtc tgg gcc ttc ctt ggc gac ggc gaa     768
Lys Asp Thr Ser Asp Gln His Val Trp Ala Phe Leu Gly Asp Gly Glu
                245             250             255

atg gac gag cca gaa tca cgt ggt ctc atc cag cag gct gca ctg aac     816
Met Asp Glu Pro Glu Ser Arg Gly Leu Ile Gln Gln Ala Ala Leu Asn
                260             265             270

aac ctg gac aac ctg acc ttc gtg gtt aac tgc aac ctg cag cgt ctc     864
Asn Leu Asp Asn Leu Thr Phe Val Val Asn Cys Asn Leu Gln Arg Leu
                275             280             285

gac gga cct gtc cgc ggt aac acc aag atc atc cag gaa ctc gag tcc     912
Asp Gly Pro Val Arg Gly Asn Thr Lys Ile Ile Gln Glu Leu Glu Ser
                290             295             300

ttc ttc cgt ggc gca ggc tgg tct gtg atc aag gtt gtt tgg ggt cgc     960
Phe Phe Arg Gly Ala Gly Trp Ser Val Ile Lys Val Val Trp Gly Arg
305             310             315             320

gag tgg gat gaa ctt ctg gag aag gac cag gat ggt gca ctt gtt gag    1008
Glu Trp Asp Glu Leu Leu Glu Lys Asp Gln Asp Gly Ala Leu Val Glu
                325             330             335

atc atg aac aac acc tcc gat ggt gac tac cag acc ttc aag gct aac    1056
Ile Met Asn Asn Thr Ser Asp Gly Asp Tyr Gln Thr Phe Lys Ala Asn
                340             345             350

gac ggc gca tat gtt cgt gag cac ttc ttc gga cgt gac cca cgc acc    1104
Asp Gly Ala Tyr Val Arg Glu His Phe Phe Gly Arg Asp Pro Arg Thr
                355             360             365

gca aag ctc gtt gag aac atg acc gac gaa gaa atc tgg aag ctg cca    1152
Ala Lys Leu Val Glu Asn Met Thr Asp Glu Glu Ile Trp Lys Leu Pro
                370             375             380

cgt ggc ggc cac gat tac cgc aag gtt tac gca gcc tac aag cga gct    1200
Arg Gly Gly His Asp Tyr Arg Lys Val Tyr Ala Ala Tyr Lys Arg Ala
385             390             395             400

ctt gag acc aag gat cgc cca acc gtc atc ctt gct cac acc att aag    1248
Leu Glu Thr Lys Asp Arg Pro Thr Val Ile Leu Ala His Thr Ile Lys
                405             410             415

ggc tac gga ctc ggc cac aac ttc gaa ggc cgt aac gca acc cac cag    1296
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Gly Tyr Gly Leu Gly His Asn Phe Glu Gly Arg Asn Ala Thr His Gln
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atg aag aag ctg acg ctt gat gat ctg aag ttg ttc cgc gac aag cag   1344
Met Lys Lys Leu Thr Leu Asp Asp Leu Lys Leu Phe Arg Asp Lys Gln
         435   440   445

ggc atc cca atc acc gat gag cag ctg gag aag gat cct tac ctt cct .   1392
Gly Ile Pro Ile Thr Asp Glu Gln Leu Glu Lys Asp Pro Tyr Leu Pro
         450   455   460

cct tac tac cac cca ggt gaa gac gct cct gaa atc aag tac atg aag   1440
Pro Tyr Tyr His Pro Gly Glu Asp Ala Pro Glu Ile Lys Tyr Met Lys
465   470   475   480

gaa cgt cgc gca gcg ctc ggt ggc tac ctg cca gag cgt cgt gag aac   1488
Glu Arg Arg Ala Ala Leu Gly Gly Tyr Leu Pro Glu Arg Arg Glu Asn
                   485   490   495

tac gat cca att cag gtt cca cca ctg gat aag ctt cgc tct gtc cgt   1536
Tyr Asp Pro Ile Gln Val Pro Pro Leu Asp Lys Leu Arg Ser Val Arg
                   500   505   510

aag ggc tcc ggc aag cag cag atc gct acc act atg gcg act gtt cgt   1584
Lys Gly Ser Gly Lys Gln Gln Ile Ala Thr Thr Met Ala Thr Val Arg
         515   520   525

acc ttc aag gaa ctg atg cgc gat aag ggc ttg gct gat cgc ctt gtc   1632
Thr Phe Lys Glu Leu Met Arg Asp Lys Gly Leu Ala Asp Arg Leu Val
         530   535   540

cca atc att cct gat gag gca cgt acc ttc ggt ctt gac tct tgg ttc   1680
Pro Ile Ile Pro Asp Glu Ala Arg Thr Phe Gly Leu Asp Ser Trp Phe
545   550   555   560

cca acc ttg aag atc tac aac ccg cac ggt cag aac tac gtg cct gtt   1728
Pro Thr Leu Lys Ile Tyr Asn Pro His Gly Gln Asn Tyr Val Pro Val
                   565   570   575

gac cac gac ctg atg ctc tcc tac cgt gag gca cct gaa gga cag atc   1776
Asp His Asp Leu Met Leu Ser Tyr Arg Glu Ala Pro Glu Gly Gln Ile
                   580   585   590

ctg cac gaa ggc atc aac gag gct ggt tcc gtg gca tcg ttc atc gct   1824
Leu His Glu Gly Ile Asn Glu Ala Gly Ser Val Ala Ser Phe Ile Ala
         595   600   605

gcg ggt acc tcc tac gcc acc cac ggc aag gcc atg att ccg ctg tac   1872
Ala Gly Thr Ser Tyr Ala Thr His Gly Lys Ala Met Ile Pro Leu Tyr
610   615   620

atc ttc tac tcg atg ttc gga ttc cag cgc acc ggt gac tcc atc tgg   1920

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gca gca gcc gat cag atg gca cgt ggc ttc ctc ttg ggc gct acc gca        1968
Ala Ala Ala Asp Gln Met Ala Arg Gly Phe Leu Leu Gly Ala Thr Ala
                645             650             655

ggt cgc acc acc ctg acc ggt gaa ggc ctc cag cac atg gat gga cac        2016
Gly Arg Thr Thr Leu Thr Gly Glu Gly Leu Gln His Met Asp Gly His
            660             665             670

tcc cct gtc ttg gct tcc acc aac gag ggt gtc gag acc tac gac cca        2064
Ser Pro Val Leu Ala Ser Thr Asn Glu Gly Val Glu Thr Tyr Asp Pro
            675             680             685

tcc ttt gcg tac gag atc gca cac ctg gtt cac cgt ggc atc gac cgc        2112
Ser Phe Ala Tyr Glu Ile Ala His Leu Val His Arg Gly Ile Asp Arg
    690             695             700

atg tac ggc cca ggc aag ggt gaa gat gtt atc tac tac atc acc atc        2160
Met Tyr Gly Pro Gly Lys Gly Glu Asp Val Ile Tyr Tyr Ile Thr Ile
705             710             715             720

tac aac gag cca acc cca cag cca gct gag cca gaa gga ctg gac gta        2208
Tyr Asn Glu Pro Thr Pro Gln Pro Ala Glu Pro Glu Gly Leu Asp Val
                725             730             735

gaa ggc ctg cac aag ggc atc tac ctc tac tcc cgc ggt gaa ggc acc        2256
Glu Gly Leu His Lys Gly Ile Tyr Leu Tyr Ser Arg Gly Glu Gly Thr
            740             745             750

ggc cat gag gca aac atc ttg gct tcc ggt gtt ggt atg cag tgg gct        2304
Gly His Glu Ala Asn Ile Leu Ala Ser Gly Val Gly Met Gln Trp Ala
            755             760             765

ctc aag gct gca tcc atc ctt gag gct gac tac gga gtt cgt gcc aac        2352
Leu Lys Ala Ala Ser Ile Leu Glu Ala Asp Tyr Gly Val Arg Ala Asn
    770             775             780

att tac tcc gct act tct tgg gtt aac ttg gct cgc gat ggc gct gct        2400
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785             790             795             800

cgt aac aag gca cag ctg cgc aac cca ggt gca gat gct ggc gag gca        2448
Arg Asn Lys Ala Gln Leu Arg Asn Pro Gly Ala Asp Ala Gly Glu Ala
                805             810             815

ttc gta acc acc cag ctg aag cag acc tcc ggc cca tac gtt gca gtg        2496
Phe Val Thr Thr Gln Leu Lys Gln Thr Ser Gly Pro Tyr Val Ala Val
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tct gac ttc tcc act gat ctg cca aac cag atc cgt gaa tgg gtc cca        2544
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ggc gac tac acc gtt ctc ggt gca gat ggc ttc ggt ttc tct gat acc          2592
Gly Asp Tyr Thr Val Leu Gly Ala Asp Gly Phe Gly Phe Ser Asp Thr
        850                 855                 860

cgc cca gct gct cgt cgc ttc ttc aac atc gac gct gag tcc att gtt          2640
Arg Pro Ala Ala Arg Arg Phe Phe Asn Ile Asp Ala Glu Ser Ile Val
865                 870                 875                 880

gtt gca gtg ctg aac tcc ctg gca cgc gaa ggc aag atc gac gtc tcc          2688
Val Ala Val Leu Asn Ser Leu Ala Arg Glu Gly Lys Ile Asp Val Ser
                885                 890                 895

gtt gct gct cag gct gct gag aag ttc aag ttg gat gat cct acg agt          2736
Val Ala Ala Gln Ala Ala Glu Lys Phe Lys Leu Asp Asp Pro Thr Ser
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Pro Glu Glu Thr Asn Glu Trp Met Asp Ser Leu Asp Gly Leu Leu Gln
        35                  40                  45


Glu Ser Ser Pro Glu Arg Ala Arg Tyr Leu Met Leu Arg Leu Leu Glu
    50                  55                  60


Arg Ala Ser Ala Lys Arg Val Ser Leu Pro Pro Met Thr Ser Thr Asp
65                  70                  75                  80


Tyr Val Asn Thr Ile Pro Thr Ser Met Glu Pro Glu Phe Pro Gly Asp
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Glu Glu Met Glu Lys Arg Tyr Arg Arg Trp Ile Arg Trp Asn Ala Ala
           100   105   110

Ile Met Val His Arg Ala Gln Arg Pro Gly Ile Gly Val Gly Gly His
          115   120   125

Ile Ser Thr Tyr Ala Gly Ala Ala Pro Leu Tyr Glu Val Gly Phe Asn
          130   135   140

His Phe Phe Arg Gly Lys Asp His Pro Gly Gly Gly Asp Gln Ile Phe
145   150   155   160

Phe Gln Gly His Ala Ser Pro Gly Met Tyr Ala Arg Ala Phe Met Glu
              165   170   175

Gly Arg Leu Ser Glu Asp Asp Leu Asp Gly Phe Arg Gln Glu Val Ser
           180   185   190

Arg Glu Gln Gly Gly Ile Pro Ser Tyr Pro His Pro His Gly Met Lys
           195   200   205

Asp Phe Trp Glu Phe Pro Thr Val Ser Met Gly Leu Gly Pro Met Asp
          210   215   220

Ala Ile Tyr Gln Ala Arg Phe Asn Arg Tyr Leu Glu Asn Arg Gly Ile
225   230   235   240

Lys Asp Thr Ser Asp Gln His Val Trp Ala Phe Leu Gly Asp Gly Glu
          245   250   255

Met Asp Glu Pro Glu Ser Arg Gly Leu Ile Gln Gln Ala Ala Leu Asn
          260   265   270

Asn Leu Asp Asn Leu Thr Phe Val Val Asn Cys Asn Leu Gln Arg Leu
          275   280   285

Asp Gly Pro Val Arg Gly Asn Thr Lys Ile Ile Gln Glu Leu Glu Ser

Phe Phe Arg Gly Ala Gly Trp Ser Val Ile Lys Val Val Trp Gly Arg
305   310   315   320

Glu Trp Asp Glu Leu Leu Glu Lys Asp Gln Asp Gly Ala Leu Val Glu
            325   330   335

Ile Met Asn Asn Thr Ser Asp Gly Asp Tyr Gln Thr Phe Lys Ala Asn
        340   345   350

Asp Gly Ala Tyr Val Arg Glu His Phe Phe Gly Arg Asp Pro Arg Thr
        355   360   365

Ala Lys Leu Val Glu Asn Met Thr Asp Glu Glu Ile Trp Lys Leu Pro
    370   375   380

Arg Gly Gly His Asp Tyr Arg Lys Val Tyr Ala Ala Tyr Lys Arg Ala
385   390   395   400

Leu Glu Thr Lys Asp Arg Pro Thr Val Ile Leu Ala His Thr Ile Lys
            405   410   415

Gly Tyr Gly Leu Gly His Asn Phe Glu Gly Arg Asn Ala Thr His Gln
            420   425   430

Met Lys Lys Leu Thr Leu Asp Asp Leu Lys Leu Phe Arg Asp Lys Gln
        435   440   445

Gly Ile Pro Ile Thr Asp Glu Gln Leu Glu Lys Asp Pro Tyr Leu Pro
    450   455   460

Pro Tyr Tyr His Pro Gly Glu Asp Ala Pro Glu Ile Lys Tyr Met Lys
465   470   475   480

Glu Arg Arg Ala Ala Leu Gly Gly Tyr Leu Pro Glu Arg Arg Glu Asn
            485   490   495

Tyr Asp Pro Ile Gln Val Pro Pro Leu Asp Lys Leu Arg Ser Val Arg

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Lys Gly Ser Gly Lys Gln Gln Ile Ala Thr Thr Met Ala Thr Val Arg
515 520 525

Thr Phe Lys Glu Leu Met Arg Asp Lys Gly Leu Ala Asp Arg Leu Val
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Pro Ile Ile Pro Asp Glu Ala Arg Thr Phe Gly Leu Asp Ser Trp Phe
545 550 555 560

Pro Thr Leu Lys Ile Tyr Asn Pro His Gly Gln Asn Tyr Val Pro Val
565 570 575

Asp His Asp Leu Met Leu Ser Tyr Arg Glu Ala Pro Glu Gly Gln Ile
580 585 590

Leu His Glu Gly Ile Asn Glu Ala Gly Ser Val Ala Ser Phe Ile Ala
595 600 605

Ala Gly Thr Ser Tyr Ala Thr His Gly Lys Ala Met Ile Pro Leu Tyr
610 615 620

Ile Phe Tyr Ser Met Phe Gly Phe Gln Arg Thr Gly Asp Ser Ile Trp
625 630 635 640

Ala Ala Ala Asp Gln Met Ala Arg Gly Phe Leu Leu Gly Ala Thr Ala
645 650 655

Gly Arg Thr Thr Leu Thr Gly Glu Gly Leu Gln His Met Asp Gly His
660 665 670

Ser Pro Val Leu Ala Ser Thr Asn Glu Gly Val Glu Thr Tyr Asp Pro
675 680 685

Ser Phe Ala Tyr Glu Ile Ala His Leu Val His Arg Gly Ile Asp Arg
690 695 700

Met Tyr Gly Pro Gly Lys Gly Glu Asp Val Ile Tyr Tyr Ile Thr Ile

Tyr Asn Glu Pro Thr Pro Gln Pro Ala Glu Pro Glu Gly Leu Asp Val
              725   730   735

Glu Gly Leu His Lys Gly Ile Tyr Leu Tyr Ser Arg Gly Glu Gly Thr
              740   745   750

Gly His Glu Ala Asn Ile Leu Ala Ser Gly Val Gly Met Gln Trp Ala
              755   760   765

Leu Lys Ala Ala Ser Ile Leu Glu Ala Asp Tyr Gly Val Arg Ala Asn
            770   775   780

Ile Tyr Ser Ala Thr Ser Trp Val Asn Leu Ala Arg Asp Gly Ala Ala
785   790   795   800

Arg Asn Lys Ala Gln Leu Arg Asn Pro Gly Ala Asp Ala Gly Glu Ala
              805   810   815

Phe Val Thr Thr Gln Leu Lys Gln Thr Ser Gly Pro Tyr Val Ala Val
              820   825   830

Ser Asp Phe Ser Thr Asp Leu Pro Asn Gln Ile Arg Glu Trp Val Pro
            835   840   845

Gly Asp Tyr Thr Val Leu Gly Ala Asp Gly Phe Gly Phe Ser Asp Thr
            850   855   860

Arg Pro Ala Ala Arg Arg Phe Phe Asn Ile Asp Ala Glu Ser Ile Val
865   870   875   880

Val Ala Val Leu Asn Ser Leu Ala Arg Glu Gly Lys Ile Asp Val Ser
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                        Met Ala Asp Gln Ala Lys Leu Gly Gly Lys Pro
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tcg gat gac tct aac ttc gcg atg atc cgc gat ggc gtg gca tct tat    2440
Ser Asp Asp Ser Asn Phe Ala Met Ile Arg Asp Gly Val Ala Ser Tyr
            15                  20                  25

ttg aac gac tca gat ccg gag gag acc aac gag tgg atg gat tca ctc    2488
Leu Asn Asp Ser Asp Pro Glu Glu Thr Asn Glu Trp Met Asp Ser Leu
        30                  35                  40
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gac gga tta ctc cag gag tct tct cca gaa cgt gct cgt tac ctc atg        2536
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    45                  50                  55

ctt cgt ttg ctt gag cgt gca tct gca aag cgc gta tct ctt ccc cca        2584
Leu Arg Leu Leu Glu Arg Ala Ser Ala Lys Arg Val Ser Leu Pro Pro
60                  65                  70                  75

atg acg tca acc gac tac gtc aac acc att cca acc tct atg gaa cct        2632
Met Thr Ser Thr Asp Tyr Val Asn Thr Ile Pro Thr Ser Met Glu Pro
                80                  85                  90

gaa ttc cca ggc gat gag gaa atg gag aag cgt tac cgt cgt tgg att        2680
Glu Phe Pro Gly Asp Glu Glu Met Glu Lys Arg Tyr Arg Arg Trp Ile
                95                  100                 105

cgc tgg aac gca gcc atc atg gtt cac cgc gct cag cga cca ggc atc        2728
Arg Trp Asn Ala Ala Ile Met Val His Arg Ala Gln Arg Pro Gly Ile
            110                 115                 120

ggc gtc ggc gga cac att tcc act tac gca ggc gca gcc cct ctg tac        2776
Gly Val Gly Gly His Ile Ser Thr Tyr Ala Gly Ala Ala Pro Leu Tyr
    125                 130                 135

gaa gtt ggc ttc aac cac ttc ttc cgc ggc aag gat cac cca ggc ggc        2824
Glu Val Gly Phe Asn His Phe Phe Arg Gly Lys Asp His Pro Gly Gly
140                 145                 150                 155

ggc gac cag atc ttc ttc cag ggc cac gca tca cca ggt atg tac gca        2872
Gly Asp Gln Ile Phe Phe Gln Gly His Ala Ser Pro Gly Met Tyr Ala
                160                 165                 170

cgt gca ttc atg gag ggt cgc ctt tct gaa gac gat ctc gat ggc ttc        2920
Arg Ala Phe Met Glu Gly Arg Leu Ser Glu Asp Asp Leu Asp Gly Phe
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cgt cag gaa gtt tcc cgt gag cag ggt ggc att ccg tcc tac cct cac        2968
Arg Gln Glu Val Ser Arg Glu Gln Gly Gly Ile Pro Ser Tyr Pro His
            190                 195                 200

cca cac ggt atg aag gac ttc tgg gag ttc cca act gtg tcc atg ggt        3016
Pro His Gly Met Lys Asp Phe Trp Glu Phe Pro Thr Val Ser Met Gly
    205                 210                 215

ctt ggc cca atg gat gcc att tac cag gca cgt ttc aac cgc tac ctc        3064
Leu Gly Pro Met Asp Ala Ile Tyr Gln Ala Arg Phe Asn Arg Tyr Leu
220                 225                 230                 235

gaa aac cgt ggc atc aag gac acc tct gac cag cac gtc tgg gcc ttc        3112
Glu Asn Arg Gly Ile Lys Asp Thr Ser Asp Gln His Val Trp Ala Phe
                240                 245                 250
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ctt ggc gac ggc gaa atg gac gag cca gaa tca cgt ggt ctc atc cag          3160
Leu Gly Asp Gly Glu Met Asp Glu Pro Glu Ser Arg Gly Leu Ile Gln
            255             260             265

cag gct gca ctg aac aac ctg gac aac ctg acc ttc gtg gtt aac tgc          3208
Gln Ala Ala Leu Asn Asn Leu Asp Asn Leu Thr Phe Val Val Asn Cys
            270             275             280

aac ctg cag cgt ctc gac gga cct gtc cgc ggt aac acc aag atc atc          3256
Asn Leu Gln Arg Leu Asp Gly Pro Val Arg Gly Asn Thr Lys Ile Ile
            285             290             295

cag gaa ctc gag tcc ttc ttc cgt ggc gca ggc tgg tct gtg atc aag          3304
Gln Glu Leu Glu Ser Phe Phe Arg Gly Ala Gly Trp Ser Val Ile Lys
300             305             310             315

gtt gtt tgg ggt cgc gag tgg gat gaa ctt ctg gag aag gac cag gat          3352
Val Val Trp Gly Arg Glu Trp Asp Glu Leu Leu Glu Lys Asp Gln Asp
                320             325             330

ggt gca ctt gtt gag atc atg aac aac acc tcc gat ggt gac tac cag          3400
Gly Ala Leu Val Glu Ile Met Asn Asn Thr Ser Asp Gly Asp Tyr Gln
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acc ttc aag gct aac gac ggc gca tat gtt cgt gag cac ttc ttc gga          3448
Thr Phe Lys Ala Asn Asp Gly Ala Tyr Val Arg Glu His Phe Phe Gly
            350             355             360

cgt gac cca cgc acc gca aag ctc gtt gag aac atg acc gac gaa gaa          3496
Arg Asp Pro Arg Thr Ala Lys Leu Val Glu Asn Met Thr Asp Glu Glu
            365             370             375

atc tgg aag ctg cca cgt ggc ggc cac gat tac cgc aag gtt tac gca          3544
Ile Trp Lys Leu Pro Arg Gly Gly His Asp Tyr Arg Lys Val Tyr Ala
380             385             390             395

gcc tac aag cga gct ctt gag acc aag gat cgc cca acc gtc atc ctt          3592
Ala Tyr Lys Arg Ala Leu Glu Thr Lys Asp Arg Pro Thr Val Ile Leu
            400             405             410

gct cac acc att aag ggc tac gga ctc ggc cac aac ttc gaa ggc cgt          3640
Ala His Thr Ile Lys Gly Tyr Gly Leu Gly His Asn Phe Glu Gly Arg
            415             420             425

aac gca acc cac cag atg aag aag ctg acg ctt gat gat ctg aag ttg          3688
Asn Ala Thr His Gln Met Lys Lys Leu Thr Leu Asp Asp Leu Lys Leu
            430             435             440

ttc cgc gac aag cag ggc atc cca atc acc gat gag cag ctg gag aag          3736
Phe Arg Asp Lys Gln Gly Ile Pro Ile Thr Asp Glu Gln Leu Glu Lys
            445             450             455
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gat cct tac ctt cct cct tac tac cac cca ggt gaa gac gct cct gaa   3784
Asp Pro Tyr Leu Pro Pro Tyr Tyr His Pro Gly Glu Asp Ala Pro Glu
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atc aag tac atg aag gaa cgt cgc gca gcg ctc ggt ggc tac ctg cca   3832
Ile Lys Tyr Met Lys Glu Arg Arg Ala Ala Leu Gly Gly Tyr Leu Pro
            480   485   490

gag cgt cgt gag aac tac gat cca att cag gtt cca cca ctg gat aag   3880
Glu Arg Arg Glu Asn Tyr Asp Pro Ile Gln Val Pro Pro Leu Asp Lys
            495   500   505

ctt cgc tct gtc cgt aag ggc tcc ggc aag cag cag atc gct acc act   3928
Leu Arg Ser Val Arg Lys Gly Ser Gly Lys Gln Gln Ile Ala Thr Thr
            510   515   520

atg gcg act gtt cgt acc ttc aag gaa ctg atg cgc gat aag ggc ttg   3976
Met Ala Thr Val Arg Thr Phe Lys Glu Leu Met Arg Asp Lys Gly Leu
    525   530   535

gct gat cgc ctt gtc cca atc att cct gat gag gca cgt acc ttc ggt   4024
Ala Asp Arg Leu Val Pro Ile Ile Pro Asp Glu Ala Arg Thr Phe Gly
540   545   550   555

ctt gac tct tgg ttc cca acc ttg aag atc tac aac ccg cac ggt cag   4072
Leu Asp Ser Trp Phe Pro Thr Leu Lys Ile Tyr Asn Pro His Gly Gln
            560   565   570

aac tac gtg cct gtt gac cac gac ctg atg ctc tcc tac cgt gag gca   4120
Asn Tyr Val Pro Val Asp His Asp Leu Met Leu Ser Tyr Arg Glu Ala
            575   580   585

cct gaa gga cag atc ctg cac gaa ggc atc aac gag gct ggt tcc gtg   4168
Pro Glu Gly Gln Ile Leu His Glu Gly Ile Asn Glu Ala Gly Ser Val
            590   595   600

gca tcg ttc atc gct gcg ggt acc tcc tac gcc acc cac ggc aag gcc   4216
Ala Ser Phe Ile Ala Ala Gly Thr Ser Tyr Ala Thr His Gly Lys Ala
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atg att ccg ctg tac atc ttc tac tcg atg ttc gga ttc cag cgc acc   4264
Met Ile Pro Leu Tyr Ile Phe Tyr Ser Met Phe Gly Phe Gln Arg Thr
620   625   630   635

ggt gac tcc atc tgg gca gca gcc gat cag atg gca cgt ggc ttc ctc   4312
Gly Asp Ser Ile Trp Ala Ala Ala Asp Gln Met Ala Arg Gly Phe Leu
            640   645   650

ttg ggc gct acc gca ggt cgc acc acc ctg acc ggt gaa ggc ctc cag   4360
Leu Gly Ala Thr Ala Gly Arg Thr Thr Leu Thr Gly Glu Gly Leu Gln
            655   660   665

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cac atg gat gga cac tcc cct gtc ttg gct tcc acc aac gag ggt gtc          4408
His Met Asp Gly His Ser Pro Val Leu Ala Ser Thr Asn Glu Gly Val
        670             675                 680

gag acc tac gac cca tcc ttt gcg tac gag atc gca cac ctg gtt cac          4456
Glu Thr Tyr Asp Pro Ser Phe Ala Tyr Glu Ile Ala His Leu Val His
        685             690                 695

cgt ggc atc gac cgc atg tac ggc cca ggc aag ggt gaa gat gtt atc          4504
Arg Gly Ile Asp Arg Met Tyr Gly Pro Gly Lys Gly Glu Asp Val Ile
700             705                 710                 715

tac tac atc acc atc tac aac gag cca acc cca cag cca gct gag cca          4552
Tyr Tyr Ile Thr Ile Tyr Asn Glu Pro Thr Pro Gln Pro Ala Glu Pro
            720                 725                 730

gaa gga ctg gac gta gaa ggc ctg cac aag ggc atc tac ctc tac tcc          4600
Glu Gly Leu Asp Val Glu Gly Leu His Lys Gly Ile Tyr Leu Tyr Ser
            735                 740                 745

cgc ggt gaa ggc acc ggc cat gag gca aac atc ttg gct tcc ggt gtt          4648
Arg Gly Glu Gly Thr Gly His Glu Ala Asn Ile Leu Ala Ser Gly Val
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ggt atg cag tgg gct ctc aag gct gca tcc atc ctt gag gct gac tac          4696
Gly Met Gln Trp Ala Leu Lys Ala Ala Ser Ile Leu Glu Ala Asp Tyr
        765                 770                 775

gga gtt cgt gcc aac att tac tcc gct act tct tgg gtt aac ttg gct          4744
Gly Val Arg Ala Asn Ile Tyr Ser Ala Thr Ser Trp Val Asn Leu Ala
780                 785                 790                 795

cgc gat ggc gct gct cgt aac aag gca cag ctg cgc aac cca ggt gca          4792
Arg Asp Gly Ala Ala Arg Asn Lys Ala Gln Leu Arg Asn Pro Gly Ala
            800                 805                 810

gat gct ggc gag gca ttc gta acc acc cag ctg aag cag acc tcc ggc          4840
Asp Ala Gly Glu Ala Phe Val Thr Thr Gln Leu Lys Gln Thr Ser Gly
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cca tac gtt gca gtg tct gac ttc tcc act gat ctg cca aac cag atc          4888
Pro Tyr Val Ala Val Ser Asp Phe Ser Thr Asp Leu Pro Asn Gln Ile
            830                 835                 840

cgt gaa tgg gtc cca ggc gac tac acc gtt ctc ggt gca gat ggc ttc          4936
Arg Glu Trp Val Pro Gly Asp Tyr Thr Val Leu Gly Ala Asp Gly Phe
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ggt ttc tct gat acc cgc cca gct gct cgt cgc ttc ttc aac atc gac          4984
Gly Phe Ser Asp Thr Arg Pro Ala Ala Arg Arg Phe Phe Asn Ile Asp
860                 865                 870                 875
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aag atc gac gtc tcc gtt gct gct cag gct gct gag aag ttc aag ttg        5080
Lys Ile Asp Val Ser Val Ala Ala Gln Ala Ala Glu Lys Phe Lys Leu
                895                         900                 905

gat gat cct acg agt gtt tcc gta gat cca aac gct cct gag gaa            5125
Asp Asp Pro Thr Ser Val Ser Val Asp Pro Asn Ala Pro Glu Glu
                910                         915                 920

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Pro Glu Glu Thr Asn Glu Trp Met Asp Ser Leu Asp Gly Leu Leu Gln
        35                  40                  45


Glu Ser Ser Pro Glu Arg Ala Arg Tyr Leu Met Leu Arg Leu Leu Glu
    50                  55                  60


Arg Ala Ser Ala Lys Arg Val Ser Leu Pro Pro Met Thr Ser Thr Asp
65                  70                  75                  80
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Tyr Val Asn Thr Ile Pro Thr Ser Met Glu Pro Glu Phe Pro Gly Asp
            85                  90                  95

Glu Glu Met Glu Lys Arg Tyr Arg Arg Trp Ile Arg Trp Asn Ala Ala
            100                 105                 110

Ile Met Val His Arg Ala Gln Arg Pro Gly Ile Gly Val Gly Gly His
            115                 120                 125

Ile Ser Thr Tyr Ala Gly Ala Ala Pro Leu Tyr Glu Val Gly Phe Asn
    130                 135                 140

His Phe Phe Arg Gly Lys Asp His Pro Gly Gly Gly Asp Gln Ile Phe
145                 150                 155                 160

Phe Gln Gly His Ala Ser Pro Gly Met Tyr Ala Arg Ala Phe Met Glu
                165                 170                 175

Gly Arg Leu Ser Glu Asp Asp Leu Asp Gly Phe Arg Gln Glu Val Ser
            180                 185                 190

Arg Glu Gln Gly Gly Ile Pro Ser Tyr Pro His Pro His Gly Met Lys
            195                 200                 205

Asp Phe Trp Glu Phe Pro Thr Val Ser Met Gly Leu Gly Pro Met Asp
    210                 215                 220

Ala Ile Tyr Gln Ala Arg Phe Asn Arg Tyr Leu Glu Asn Arg Gly Ile
225                 230                 235                 240

Lys Asp Thr Ser Asp Gln His Val Trp Ala Phe Leu Gly Asp Gly Glu
                245                 250                 255

Met Asp Glu Pro Glu Ser Arg Gly Leu Ile Gln Gln Ala Ala Leu Asn
            260                 265                 270

Asn Leu Asp Asn Leu Thr Phe Val Val Asn Cys Asn Leu Gln Arg Leu
            275                 280                 285
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Asp Gly Pro Val Arg Gly Asn Thr Lys Ile Ile Gln Glu Leu Glu Ser
290   295   300

Phe Phe Arg Gly Ala Gly Trp Ser Val Ile Lys Val Val Trp Gly Arg
305   310   315   320

Glu Trp Asp Glu Leu Leu Glu Lys Asp Gln Asp Gly Ala Leu Val Glu
            325   330   335

Ile Met Asn Asn Thr Ser Asp Gly Asp Tyr Gln Thr Phe Lys Ala Asn
            340   345   350

Asp Gly Ala Tyr Val Arg Glu His Phe Phe Gly Arg Asp Pro Arg Thr
            355   360   365

Ala Lys Leu Val Glu Asn Met Thr Asp Glu Glu Ile Trp Lys Leu Pro
            370   375   380

Arg Gly Gly His Asp Tyr Arg Lys Val Tyr Ala Ala Tyr Lys Arg Ala
385   390   395   400

Leu Glu Thr Lys Asp Arg Pro Thr Val Ile Leu Ala His Thr Ile Lys
            405   410   415

Gly Tyr Gly Leu Gly His Asn Phe Glu Gly Arg Asn Ala Thr His Gln
            420   425   430

Met Lys Lys Leu Thr Leu Asp Asp Leu Lys Leu Phe Arg Asp Lys Gln
            435   440   445

Gly Ile Pro Ile Thr Asp Glu Gln Leu Glu Lys Asp Pro Tyr Leu Pro
            450   455   460

Pro Tyr Tyr His Pro Gly Glu Asp Ala Pro Glu Ile Lys Tyr Met Lys
465   470   475   480

Glu Arg Arg Ala Ala Leu Gly Gly Tyr Leu Pro Glu Arg Arg Glu Asn
            485   490   495

Tyr Asp Pro Ile Gln Val Pro Pro Leu Asp Lys Leu Arg Ser Val Arg
        500   505   510

Lys Gly Ser Gly Lys Gln Gln Ile Ala Thr Thr Met Ala Thr Val Arg
        515   520   525

Thr Phe Lys Glu Leu Met Arg Asp Lys Gly Leu Ala Asp Arg Leu Val
        530   535   540

Pro Ile Ile Pro Asp Glu Ala Arg Thr Phe Gly Leu Asp Ser Trp Phe
545   550   555   560

Pro Thr Leu Lys Ile Tyr Asn Pro His Gly Gln Asn Tyr Val Pro Val
                565   570   575

Asp His Asp Leu Met Leu Ser Tyr Arg Glu Ala Pro Glu Gly Gln Ile
            580   585   590

Leu His Glu Gly Ile Asn Glu Ala Gly Ser Val Ala Ser Phe Ile Ala
        595   600   605

Ala Gly Thr Ser Tyr Ala Thr His Gly Lys Ala Met Ile Pro Leu Tyr
        610   615   620

Ile Phe Tyr Ser Met Phe Gly Phe Gln Arg Thr Gly Asp Ser Ile Trp
625   630   635   640

Ala Ala Ala Asp Gln Met Ala Arg Gly Phe Leu Leu Gly Ala Thr Ala
            645   650   655

Gly Arg Thr Thr Leu Thr Gly Glu Gly Leu Gln His Met Asp Gly His
        660   665   670

Ser Pro Val Leu Ala Ser Thr Asn Glu Gly Val Glu Thr Tyr Asp Pro
        675   680   685

Ser Phe Ala Tyr Glu Ile Ala His Leu Val His Arg Gly Ile Asp Arg
        690   695   700

Met Tyr Gly Pro Gly Lys Gly Glu Asp Val Ile Tyr Tyr Ile Thr Ile
705   710   715   720

Tyr Asn Glu Pro Thr Pro Gln Pro Ala Glu Pro Glu Gly Leu Asp Val
                725   730   735

Glu Gly Leu His Lys Gly Ile Tyr Leu Tyr Ser Arg Gly Glu Gly Thr
              740   745   750

Gly His Glu Ala Asn Ile Leu Ala Ser Gly Val Gly Met Gln Trp Ala
          755   760   765

Leu Lys Ala Ala Ser Ile Leu Glu Ala Asp Tyr Gly Val Arg Ala Asn
    770   775   780

Ile Tyr Ser Ala Thr Ser Trp Val Asn Leu Ala Arg Asp Gly Ala Ala
785   790   795   800

Arg Asn Lys Ala Gln Leu Arg Asn Pro Gly Ala Asp Ala Gly Glu Ala
              805   810   815

Phe Val Thr Thr Gln Leu Lys Gln Thr Ser Gly Pro Tyr Val Ala Val
          820   825   830

Ser Asp Phe Ser Thr Asp Leu Pro Asn Gln Ile Arg Glu Trp Val Pro
    835   840   845

Gly Asp Tyr Thr Val Leu Gly Ala Asp Gly Phe Gly Phe Ser Asp Thr
    850   855   860

Arg Pro Ala Ala Arg Arg Phe Phe Asn Ile Asp Ala Glu Ser Ile Val
865   870   875   880

Val Ala Val Leu Asn Ser Leu Ala Arg Glu Gly Lys Ile Asp Val Ser
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Val Ser Val Asp Pro Asn Ala Pro Glu Glu
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